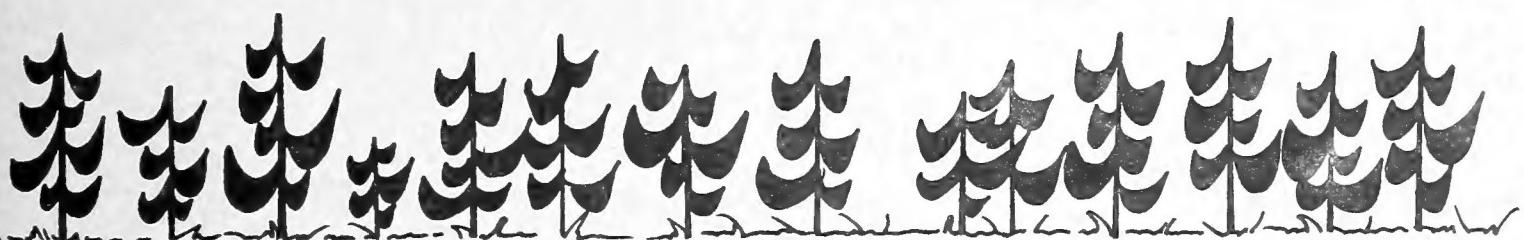


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The Land Base for Management of Young-growth Forests in the Douglas-fir Region,

2501
Roger D. Fight,
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(*Pseudotsuga menziesii*, statistics)

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ABSTRACT

The condition and extent of existing young-growth stands in the Douglas-fir region are presented in terms of age, site, and stocking for major owner groups and States. The tables enable the reader to identify possibilities for intensification of management.

KEYWORDS: *Timber management, Douglas-fir region, young growth.*

INTRODUCTION

Old-growth timber in the Douglas-fir region is an important determinant of the supply of timber products from western Washington and western Oregon. However, as the conversion of the Douglas-fir region forests from old growth to young growth continues, the extent and condition of the young-growth component assume a growing role in the determination of future supply. Because of this, it is important that we have information about the young-growth component that can be used to draw inferences about potential timber supplies.

The basic pieces of biological data needed to make projections are age, site productivity, and stocking of the existing forest. These data when combined with appropriate response data, assumed management regimes, and harvesting strategies can be used to project forest inventories.

The U.S. Forest Service is again reviewing potential timber supplies from the Nation's commercial forest land. Earlier studies in this series were the 1953 "Timber Resource Review" and the 1962 "Timber Trends in the U.S." The current effort will present forest resource statistics as of 1970 and projections of future timber supply under alternative management levels. The data presented in this paper with the exception of National Forests were those used in examining the increased yields possible under intensified management. Data are provided for those who wish to examine this data base and for those who may wish to answer a different supply-related question. The projections of yields possible under alternative management levels for National Forests in Oregon and Washington were made by the Regional Office of the U.S. Forest Service, using data from the same inventories but not necessarily in the format shown in this report. However, we have developed data in the same format for some National Forests as for other owners where there is a suitable inventory so the condition of National Forests might be compared with other ownerships.

This paper presents, for all owners (National Forest, other public, forest industry, and other private), area by stand type, age class, productivity, stocking class, and, for some age classes, trees per acre. This type of data is available only for five National Forests. These are the south Mount Baker Working Circle and the Gifford Pinchot in western Washington and the Siskiyou, Umpqua, and Rogue River in western Oregon. In addition, we have prepared for all National Forests a table which shows area by age class.

The physical strata identified in this paper provide a necessary ingredient for identifying treatment opportunities such as commercial and precommercial thinning, fertilization, and stand conversion; they also provide a basis for economic evaluation. We recognize that landowners will have differing management objectives, and the "opportunities" we have identified are based on arbitrary standards. Although these may not serve anyone's needs perfectly, they do provide a benchmark for at least identifying the limits of the opportunities to increase timber supplies through intensive management.

DEFINITIONS OF CLASSIFICATION VARIABLES

A brief discussion of our procedure is presented here so that the reasonableness and relevance of our approach can be judged. A more detailed description of the procedure is available in the appendix.

Using the data from individual Forest Survey inventory plots, we computed a stocking for each live sound tree of commercial species; this stocking was based on the number of trees of that average diameter and species needed to approximate normal stocking.¹ Then looking at the total hardwood and conifer stockings, we assigned each plot to a "conifer," "hardwood," or "other" category. In general, "other" indicates less than 10 percent of normal stocking in conifers and less than 10 percent of normal stocking in hardwoods; the combined stocking of conifers and hardwoods might exceed 10 percent. "Conifer" or "hardwood" shows which stocking was greater relative to normal for those species. The predominance of stocking was used to assign a specific 10-year stand age to each hardwood and each conifer stand. Each conifer stand in each age class was then assigned to a stocking class that was defined in terms of percent of normal stocking. For young stands (ages 15 and 25), we computed stems per acre for all trees--sapling size and larger. When computing stocking on saw-timber size stands, we ignored understory components that were unlikely to yield any commercial products. We identified low, medium, and high conifer productivity classes.

Douglas-fir site III (site indices 130, 140, and 150) is the basis for our "medium" productivity class. Douglas-fir site indices above 150 and below 130 are assigned to our "high" and "low" classes, respectively. Other species were assigned to these categories based on their approximate equivalence to Douglas-fir in terms of cubic-foot mean annual increment at culmination.

IDENTIFYING TREATMENT OPPORTUNITIES

Identifying candidate stands for hardwood conversion was not difficult with our data base. We included all hardwood stands that were on sites that showed evidence of having supported a conifer stand in the past. The age and productivity stratification provide a partial basis for determining the economics of conversion.

It is generally accepted that commercial thinnings should reduce stocking to about 60 percent of normal basal area. This is apparently based on the reasoning that 60 percent of normal basal area will maintain full normal growth.²

¹Richard E. McArdle, Walter H. Meyer, and Donald Bruce. *The yield of Douglas-fir in the Pacific Northwest.* USDA Tech. Bull. No. 201, p. 11 and 12 and table 2. Rev. 1961.

²The 60-percent figure is accepted by a number of agencies including the Bureau of Land Management and U.S. Forest Service; the concept that less than full stocking will produce full growth is presented in a number of sources, including David H. Smith, *The practice of silviculture*, New York, John Wiley and Sons, p. 43, 1962.

In order to use this thinning guide, there must be some trees in excess of this figure. We chose 70 percent.

All stands that are candidates for commercial thinning are considered candidates for fertilization as well. In addition we have considered that stands with 40- to 69-percent stocking are candidates for fertilization.

For stands aged 15 and 25, we said that they must have at least 30 percent of normal stocking and more than 450 trees per acre to be considered for pre-commercial thinning. This is admittedly an arbitrary standard; however, work in the economics of precommercial thinning in the Douglas-fir region is virtually, if not in fact, nonexistent.

For regeneration candidates we included all stands with less than 30 percent of normal stocking; for stands 45 years and over, we also included all those with 30 to 39 percent of normal stocking.

Although further stratification would have yielded categories that were more homogeneous, we felt that this degree of stratification was sufficient considering the biological response data and projection model that we planned to use. Figure 1 shows how the stands were combined into treatment opportunity classes.

DISCUSSION OF TABLES

Data in all tables come from inventories of various years. For this reason, we cannot expect totals to agree with other published data which are generally adjusted for recent changes in land use and to a common point in time. The amount of detail in these tables makes this kind of adjustment infeasible. This does not detract from these data as an estimate of the relative condition of forests in western Washington and western Oregon. However, totals should be used cautiously where these kinds of adjustments are important.

For all owners except National Forest, table 1 shows the total area of commercial forest land in conifer stands, hardwood stands on conifer sites and on hardwood sites, and other by productivity class in western Oregon and western Washington. Data for five National Forest working circles are shown in table 2.

For the same owners and regions, table 3 shows the area of hardwood stands on conifer sites by age of stand. These have been classified according to their potential for conifer production. There is no comparable table for the five National Forest working circles because there were no such acres identified. The acreage shown here sets an upper limit on the opportunity for converting hardwood stands to conifer. The age of the existing hardwood stands and their potential for conifer production are useful for estimating the economic feasibility of the alternative to convert hardwood stands to conifer.

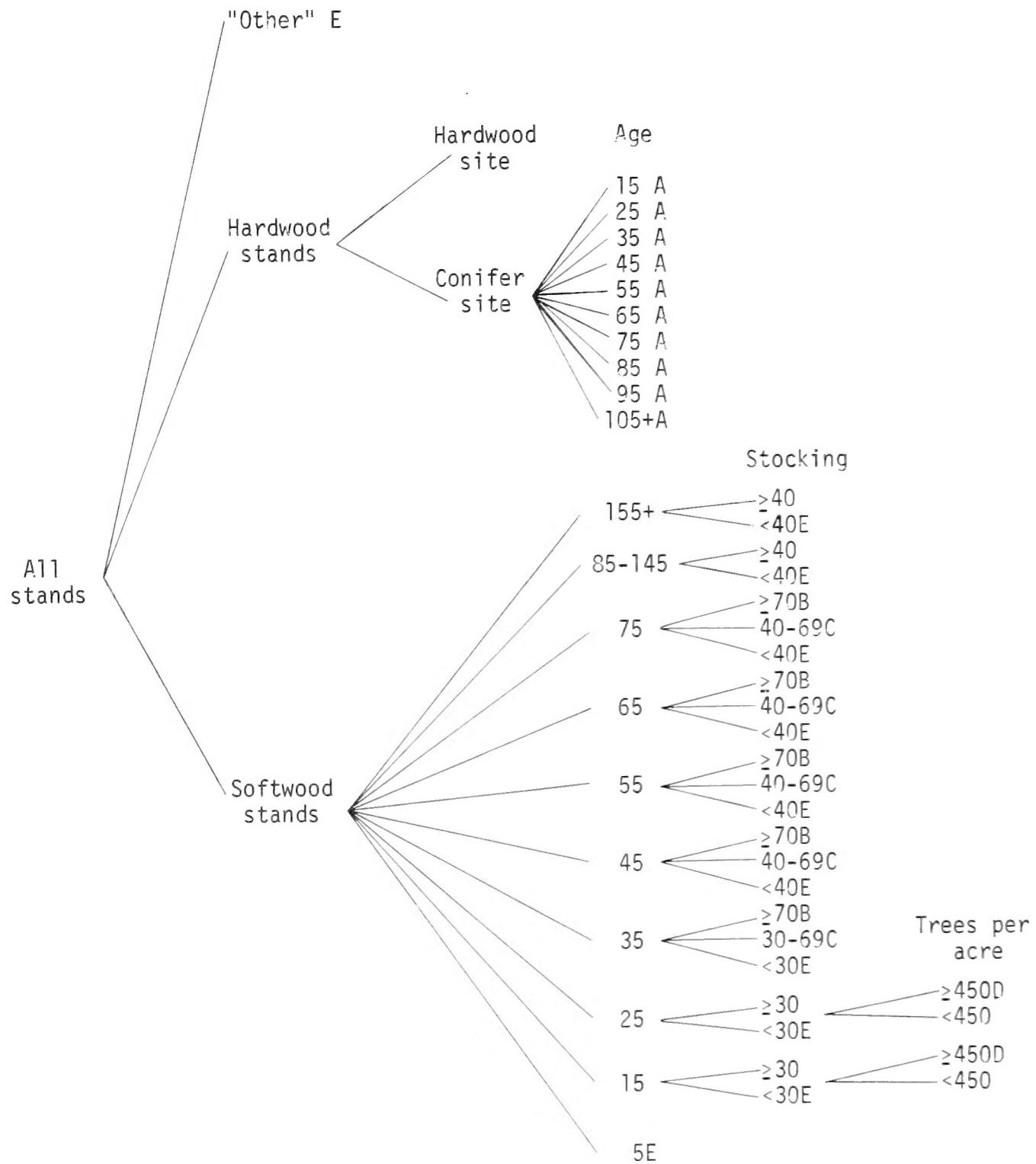


Figure 1.--Identification of treatment possibilities. For convenience, productivity stratification is not shown in this figure but is available in the tables. Possible treatments: A - Convert to conifer; B - Commercial thin, commercial thin and fertilize; C - Fertilize; D - Precommercial thin; E - Clean and weed or regenerate.

Tables 4, 5, and 6 show by State and owner the area in conifer stands by age, productivity, and stocking classes. Table 7 shows the same data for five National Forest working circles. These data can be used to delimit the opportunities for commercial thinning and fertilization.

Tables 8 and 9 can be used to delimit the opportunities for spacing control. The 450-tree limit per acre represents an average spacing of approximately 10 by 10 feet.

Table 10 includes all Region 6 National Forest areas in western Oregon and western Washington. These data, which show area by age, come from Region 6 timber management plans and inventory statistics and were essential to the calculation of most existing allowable cuts. Table 10 has been included so that the total commercial forest land in western Oregon and western Washington for each owner can be accounted for in a format basic to analysis of the area's timber harvesting potential.

CONCLUSIONS

The data provided here are a necessary ingredient to any serious consideration of future timber supplies in the Douglas-fir region. Although the actual limits used to identify opportunities might vary according to others' opinions of owner objectives or to local conditions, these data still provide a valid basis for estimating the extent of management opportunities.

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Totals have been maintained to agree with original data and may not agree with rounded entries shown in these tables.

Table 1.--Area^{1/} of commercial forest land by conifer productivity class, stand type, and owner in western Washington and western Oregon
 (In acres)

Stand type	Other public ^{2/}			Forest industry			Other private					
	High	Medium	Low	Total	High	Medium	Low	Total	High	Medium	Low	Total
<i>Western Washington</i>												
Conifer stands	606,000	431,000	419,000	1,456,000	1,372,000	756,000	547,000	2,674,000	366,000	388,000	524,000	1,279,000
Hardwood stands on conifer sites	136,000	92,000	44,000	271,000	216,000	194,000	143,000	553,000	243,000	240,000	199,000	682,000
Other	29,000	18,000	6,000	54,000	135,000	34,000	76,000	245,000	67,000	26,000	67,000	160,000
Total	771,000	541,000	469,000	1,781,000	1,723,000	984,000	765,000	3,473,000	677,000	653,000	791,000	2,120,000
<i>Western Oregon</i>												
Conifer stands	972,000	503,000	594,000	2,069,000	992,000	636,000	682,000	2,310,000	594,000	383,000	448,000	1,425,000
Hardwood stands on conifer sites	193,000	62,000	192,000	448,000	239,000	89,000	94,000	422,000	294,000	244,000	336,000	874,000
Other	102,000	125,000	274,000	500,000	221,000	184,000	331,000	735,000	194,000	160,000	488,000	842,000
Total	1,268,000	690,000	1,060,000	3,017,000	1,451,000	908,000	1,108,000	3,467,000	1,081,000	787,000	1,272,000	3,140,000
<i>Hardwood stands on hardwood sites</i>												
Total	(3/)	(3/)	(3/)	1,833,000	(3/)	(3/)	(3/)	3,634,000	(3/)	(3/)	(3/)	183,000
												2,304,000

^{1/} Data are as of date of inventory and have not been adjusted to agree with updated area statistics. Inventory dates are: western Oregon, 1961-62; southwest Washington, 1963; Olympic Peninsula, 1965; and Puget Sound, 1966.

^{2/} All public ownerships except National Forests.

^{3/} Not available.

Table 2.--Area^{1/} of commercial forest land by conifer productivity class and stand type for five National Forest working circles in western Washington and western Oregon

(In acres)

Stand type	High	Medium	Low	Total
<i>Western Washington</i>				
Conifer stands	251,000	246,000	621,000	1,119,000
Hardwood stands on conifer sites	--	--	--	--
Other	13,000	17,000	29,000	59,000
Hardwood stands on hardwood sites	--	--	--	--
Total	264,000	263,000	650,000	1,178,000
<i>Western Oregon</i>				
Conifer stands	114,000	474,000	1,428,000	2,016,000
Hardwood stands on conifer sites	--	--	--	--
Other	6,000	16,000	82,000	104,000
Hardwood stands on hardwood sites	--	6,000	41,000	47,000
Total	119,000	496,000	1,552,000	2,167,000

^{1/} Data as of date of inventory. Inventory dates of National Forest working circles are: south Mount Baker, 1965; Gifford Pinchot, 1969; Rogue River, 1967; Siskiyou, 1967; and Umpqua, 1968-69.

Table 3.--Area^{1/} of hardwood stands on conifer sites by age class, productivity, and owner in western Washington and western Oregon
(In acres)

Age class	Other public ^{2/}			Forest industry			Other private					
	High	Medium	Low	Total	High	Medium	Low	Total	High	Medium	Low	Total
<i>Western Washington</i>												
5	18,000	9,000	13,000	39,000	18,000	28,000	19,000	65,000	14,000	38,000	35,000	87,000
15	45,000	6,000	10,000	61,000	22,000	29,000	62,000	113,000	43,000	58,000	44,000	145,000
25	21,000	22,000	13,000	56,000	59,000	34,000	31,000	124,000	22,000	48,000	11,000	81,000
35	37,000	36,000	--	73,000	33,000	76,000	11,000	120,000	112,000	54,000	24,000	190,000
45	12,000	6,000	--	19,000	19,000	6,000	11,000	36,000	30,000	8,000	47,000	86,000
55	--	5,000	7,000	12,000	34,000	8,000	2,000	45,000	11,000	22,000	28,000	61,000
65	3,000	6,000	1,000	10,000	16,000	7,000	--	--	--	--	--	--
75	--	--	--	--	8,000	6,000	--	--	14,000	--	8,000	8,000
85	--	--	--	--	--	--	--	--	--	--	--	--
95	--	--	--	--	--	7,000	--	--	6,000	13,000	11,000	3,000
105+	--	--	--	--	--	--	--	--	--	--	--	--
Total	136,000	92,000	44,000	271,000	216,000	194,000	143,000	553,000	243,000	240,000	199,000	682,000
<i>Western Oregon</i>												
5	7,000	23,000	165,000	195,000	7,000	20,000	56,000	83,000	23,000	7,000	140,000	170,000
15	48,000	2,000	13,000	62,000	60,000	26,000	18,000	104,000	52,000	31,000	27,000	111,000
25	15,000	--	--	15,000	11,000	9,000	2,000	22,000	13,000	4,000	22,000	39,000
35	63,000	7,000	1,000	71,000	75,000	9,000	10,000	95,000	46,000	66,000	34,000	146,000
45	--	21,000	--	21,000	13,000	--	--	13,000	40,000	32,000	14,000	86,000
55	49,000	--	--	49,000	24,000	--	8,000	32,000	74,000	45,000	57,000	176,000
65	1,000	4,000	1,000	7,000	8,000	--	--	8,000	24,000	2,000	10,000	36,000
75	5,000	7,000	--	12,000	6,000	22,000	--	29,000	--	29,000	--	29,000
85	--	--	--	--	--	--	--	--	2,000	2,000	10,000	14,000
95	5,000	1,000	9,000	15,000	19,000	2,000	2,000	22,000	12,000	12,000	14,000	37,000
105+	--	--	--	--	15,000	--	--	15,000	8,000	15,000	8,000	30,000
Total	193,000	62,000	192,000	448,000	239,000	89,000	94,000	422,000	294,000	244,000	336,000	874,000

^{1/} Data are as of date of inventory and have not been adjusted to agree with updated area statistics. Inventory dates are: Western Oregon, 1961-62; southwest Washington, 1963; Olympic Peninsula, 1965; and Puget Sound, 1966.

^{2/} All public ownerships except National Forests.

Table 4.--Area^{1/} of conifer stands by stocking, age class, and productivity on other public lands^{2/}
in western Washington and western Oregon
 (In acres)

Age class	Stocking 70+			Stocking 40-69			Stocking 0-39			Total	
	High	Medium	Low	High	Medium	Low	High	Medium	Low		
<i>Western Washington</i>											
15 ^{3/}				61,000	44,000	32,000	137,000			5,000	
25				13,000	41,000	27,000	81,000	--		10,000	
35	39,000	19,000	34,000	66,000	44,000	44,000	113,000	--		25,000	
45	55,000	15,000	8,000	78,000	17,000	30,000	47,000	24,000		15,000	
55	16,000	6,000	--	23,000	8,000	8,000	5,000	21,000		8,000	
65	5,000	17,000	--	22,000	7,000	3,000	2,000	12,000		3,000	
75 ^{5/}	11,000	3,000	9,000	22,000	5,000	--	3,000	8,000		5,000	
85 ^{5/}					14,000	13,000	--	27,000		--	
95				9,000	--	8,000	4,000	13,000		--	
105					--	8,000	4,000	14,000		--	
115					20,000	--	25,000	22,000		--	
125					2,000	--	5,000	45,000		2,000	
135					3,000	--	5,000	7,000		3,000	
145					8,000	--	5,000	8,000		8,000	
155					--	--	5,000	5,000		--	
165					5,000	--	--	5,000		5,000	
175					8,000	--	--	8,000		8,000	
185					24,000	--	--	24,000		--	
195					--	--	--	--		7,000	
250					74,000	13,000	18,000	105,000		--	
350					69,000	15,000	40,000	174,000		--	
Total	126,000	60,000	52,000	238,000	428,000	309,000	236,000	973,000	52,000	62,000	
									132,000	246,000	

See footnotes at end of table, p. 11.

Table 4.--Area^{1/} of conifer stands by stocking, age class, and productivity on other public lands^{2/}
in western Washington and western Oregon (continued)

(In acres)

Age class	Stocking 70+			Stocking 40-69			Stocking 0-39					
	High	Medium	Low	Total	High	Medium	Low	Total	High	Medium	Low	Total
Western Oregon												
5 ^{3/}												
15 ^{4/}												
25												
35	23,000	7,000	--	30,000	14,000	8,000	7,000	26,000	69,000	119,000	44,000	10,000
45	10,000	--	--	10,000	19,000	--	--	21,000	29,000	7,000	21,000	2,000
55	--	16,000	13,000	30,000	46,000	19,000	22,000	19,000	22,000	8,000	26,000	56,000
65	29,000	18,000	--	46,000	51,000	19,000	23,000	93,000	87,000	14,000	14,000	--
75 ^{5/}	27,000	34,000	7,000	68,000	63,000	--	--	14,000	77,000	7,000	7,000	15,000
85 ^{5/}												
95												
105												
115												
125												
135												
145												
155												
165												
175												
185												
195												
250												
350												
Total	89,000	75,000	20,000	184,000	698,000	325,000	370,000	1,393,000	185,000	103,000	204,000	492,000

1/ Data are as of date of inventory and have not been adjusted to agree with updated area statistics. Inventory dates are:
western Oregon, 1961-62; southwest Washington, 1963; Olympic Peninsula, 1965; and Puget Sound, 1966.

2/ All public ownerships except National Forests.

3/ For age 5 all stocking categories are combined.

4/ For ages 15, 25, and 35 stocking limits are 0-29 and 30+. For ages 15 and 25 all stocking 30+ is combined.

5/ For ages 85+ all stocking 40+ is combined.

Table 5.--Area^{1/} of conifer stands by stocking, age class, and productivity on forest industry lands
in western Washington and western Oregon
(In acres)

Age class	Stocking 70+			Stocking 40-69			Stocking 0-39					
	High	Medium	Low	Total	High	Medium	Low	Total	High	Medium	Low	Total
Western Washington												
5 ^{2/} 3/					196,000	97,000	98,000	391,000	25,000	25,000	34,000	84,000
15					73,000	54,000	42,000	169,000	29,000	28,000	16,000	73,000
25					76,000	47,000	21,000	144,000	29,000	33,000	29,000	106,000
35	58,000	23,000	8,000	89,000	88,000	78,000	18,000	184,000	44,000	10,000	14,000	38,000
45	28,000	26,000	8,000	62,000	69,000	43,000	18,000	129,000	14,000	10,000	14,000	34,000
55	38,000	14,000	12,000	64,000	45,000	36,000	7,000	87,000	6,000	17,000	11,000	37,000
65	19,000	--	9,000	28,000	49,000	9,000	7,000	65,000	13,000	17,000	6,000	12,000
75 ^{4/}	11,000	5,000	--	16,000	6,000	--	3,000	9,000	6,000	--	6,000	14,000
85					25,000	18,000	11,000	55,000	3,000	3,000	--	11,000
95					43,000	11,000	4,000	59,000	16,000	--	--	16,000
105					22,000	22,000	11,000	55,000				
115					33,000	7,000	14,000	54,000				
125					27,000	3,000	--	30,000	11,000	4,000	11,000	25,000
135					22,000	6,000	6,000	34,000				
145					13,000	2,000	--	15,000				
155					14,000	--	4,000	14,000				
165					--	4,000	--	4,000				
175					13,000	4,000	--	17,000				
185					90,000	39,000	43,000	173,000	66,000	29,000	20,000	115,000
195					--	--	--	--	--			
250					47,000	23,000	15,000	84,000				
350					33,000	24,000	34,000	91,000				
Total	154,000	69,000	37,000	260,000	984,000	525,000	354,000	1,862,000	234,000	162,000	156,000	552,000

See footnotes at end of table, p. 13.

Table 5.—Area^{1/} of conifer stands by stocking, age class, and productivity on forest industry lands
in western Washington and western Oregon (continued)

(In acres)

Age class	Stocking 70+			Stocking 40-69			Stocking 0-39					
	High	Medium	Low	Total	High	Medium	Low	Total	High	Medium	Low	Total
Western Oregon												
15 ^{2/}					85,000	70,000	282,000	78,000	49,000	47,000	174,000	
25					30,000	35,000	63,000	129,000	14,000	--	14,000	
35	40,000	--	7,000	47,000	43,000	16,000	8,000	67,000	41,000	33,000	3,000	
45	--	--	--	--	7,000	38,000	22,000	132,000	14,000	--	8,000	
55	14,000	--	--	--	31,000	15,000	15,000	37,000	47,000	--	28,000	
65	22,000	8,000	--	--	29,000	7,000	15,000	23,000	45,000	8,000	8,000	
75 ^{4/}	8,000	14,000	--	--	22,000	22,000	--	--	29,000	15,000	13,000	30,000
85 ^{4/}					38,000	22,000	--	60,000	7,000	--	22,000	29,000
95					32,000	8,000	21,000	61,000	14,000	16,000	23,000	53,000
105					25,000	8,000	18,000	50,000	--	14,000	--	
115					14,000	--	--	14,000	--	8,000	8,000	
125					--	--	--	8,000	--	8,000	8,000	
135					--	--	--	8,000	--	8,000	8,000	
145					15,000	8,000	8,000	30,000	--	7,000	15,000	58,000
155					--	7,000	8,000	15,000	--	--	--	
165					--	--	--	--	--	--	--	
175					--	--	--	--	--	--	--	
185					244,000	157,000	106,000	507,000	43,000	61,000	46,000	150,000
195					--	--	--	--	--	--	--	
250					--	--	--	--	--	--	--	
350					--	--	--	--	--	--	--	
Total	83,000	22,000	7,000	112,000	666,000	420,000	433,000	1,519,000	243,000	194,000	242,000	679,000

^{1/} Data are as of date of inventory and have not been adjusted to agree with updated area statistics. Inventory dates are:
western Oregon, 1961-62; southwest Washington, 1963; Olympic Peninsula, 1965; and Puget Sound, 1966.

^{2/} For age 5 all stocking categories are combined.

^{3/} For ages 15, 25, and 35 stocking limits are 0-29 and 30+. For ages 15 and 25 all stocking 30+ is combined.

^{4/} For ages 85+ all stocking 40+ is combined.

Table 6.--Area^{1/} of conifer stands by stocking, age class, and productivity on other private lands
in western Washington and western Oregon
(In acres)

Age class	Stocking 70+			Stocking 40-69			Stocking 0-39			Total
	High	Medium	Low	Total	High	Medium	Low	Total	High	
Western Washington										
5 ^{2/}					25,000	45,000	93,000			
15 ^{3/}					11,000	23,000	50,000			
25					22,000	57,000	103,000	20,000		
35	8,000	26,000	15,000	50,000	46,000	20,000	112,000	20,000	18,000	
45	13,000	9,000	17,000	39,000	49,000	10,000	26,000	86,000	41,000	57,000
55	17,000	10,000	5,000	32,000	14,000	35,000	22,000	72,000	3,000	23,000
65	4,000	--	6,000	10,000	10,000	7,000	10,000	27,000	--	25,000
75 ^{4/}	10,000	--	10,000	13,000	--	13,000	2,000	12,000	27,000	9,000
85							4,000	--	4,000	--
95							--	--	4,000	7,000
105							--	--	1,000	1,000
115							--	--	2,000	3,000
125							--	--	8,000	8,000
135							--	--	--	--
145							--	--	--	--
155							--	--	2,000	2,000
165							--	--	--	--
175							8,000	--	5,000	8,000
185							--	--	7,000	7,000
195							--	--	3,000	3,000
250							3,000	3,000	10,000	12,000
350							--	--	12,000	--
Total	52,000	45,000	43,000	140,000	213,000	185,000	234,000	631,000	101,000	158,000
										248,000
										507,000

See footnotes at end of table, p. 15.

Table 6.—Area^{1/} of conifer stands by stocking, age class, and productivity on other private lands
in western Washington and western Oregon (continued)

(In acres)

Age class	Stocking 70+			Stocking 40-69			Stocking 0-39			Total	
	High	Medium	Low	Total	High	Medium	Low	Total	High	Medium	Low
<i>Western Oregon</i>											
5 ^{2/} 15 ^{3/}	32,000	26,000	80,000	138,000	29,000	35,000	12,000	76,000			
25	30,000	21,000	--	52,000	--	--	21,000	29,000			
35	45,000	21,000	--	66,000	8,000	8,000	--				
45	--	7,000	15,000	89,000	39,000	7,000	135,000	80,000	15,000	39,000	134,000
55	14,000	13,000	7,000	20,000	14,000	7,000	8,000	30,000	17,000	14,000	38,000
65	--	8,000	--	22,000	23,000	8,000	--	30,000	20,000	45,000	110,000
75 ^{4/}	--	8,000	--	8,000	23,000	--	16,000	39,000	40,000	9,000	18,000
85 ^{4/}	--	--	7,000	7,000	--	7,000	14,000	14,000	10,000	23,000	56,000
95	--	--	--	--	43,000	--	--	57,000	3,000	2,000	52,000
105	--	--	--	--	14,000	7,000	--	21,000	--	8,000	45,000
115	--	--	--	--	9,000	9,000	--	7,000	7,000	9,000	47,000
125	--	--	--	--	8,000	8,000	--	15,000	15,000	9,000	23,000
135	--	--	--	--	7,000	--	--	7,000	7,000	--	
145	--	--	--	--	7,000	--	--	7,000	7,000	--	
155	--	--	--	--	7,000	--	--	7,000	7,000	--	
165	--	--	--	--	7,000	--	--	7,000	7,000	--	
175	--	--	--	--	7,000	--	--	7,000	7,000	--	
185	--	--	--	--	7,000	--	--	7,000	7,000	--	
195	--	--	--	--	7,000	--	--	7,000	7,000	--	
250	--	--	--	--	7,000	--	--	7,000	7,000	--	
350	--	--	--	--	7,000	--	--	7,000	7,000	--	
Total	22,000	29,000	21,000	71,000	342,000	188,000	142,000	672,000	231,000	166,000	285,000
											682,000

^{1/} Data are as of date of inventory and have not been adjusted to agree with updated area statistics. Inventory dates are:
western Oregon, 1961-62; southwest Washington, 1963; Olympic Peninsula, 1965; and Puget Sound, 1966.

^{2/} For age 5 all stocking categories are combined.

^{3/} For ages 15, 25, and 35 stocking limits are 0-29 and 30+. For ages 15 and 25 all stocking 30+ is combined.

^{4/} For ages 85+ all stocking 40+ is combined.

Table 7.—Area^{1/} of conifer stands by stocking, age class, and productivity on five National Forest working circles
in western Washington and western Oregon
(In acres)

Age class	Stocking 70+			Stocking 40-69			Stocking 0-39					
	High	Medium	Low	Total	High	Medium	Low	Total	High	Medium	Low	Total
<i>Western Washington</i>												
5 ^{2/} 15 ^{3/}					17,000	21,000	63,000	100,000				
25	2,000	4,000	17,000	23,000					2,000	6,000	6,000	7,000
35	--	2,000	6,000	8,000					--	--	6,000	6,000
45	--	6,000	19,000	25,000					7,000	6,000	6,000	13,000
55	4,000	11,000	25,000	40,000	12,000	2,000	24,000	38,000			6,000	6,000
65	6,000	6,000	25,000	38,000	--	6,000	15,000	21,000			6,000	8,000
75 ^{4/}	4,000	2,000	11,000	17,000	--	2,000	19,000	21,000			6,000	6,000
85 ^{4/}					4,000	6,000	8,000	17,000			2,000	2,000
95					--	4,000	17,000	21,000			--	--
105					--	13,000	29,000	42,000			--	--
115					9,000	4,000	21,000	34,000			2,000	6,000
125					6,000	4,000	19,000	28,000			2,000	6,000
135					--	2,000	17,000	19,000			2,000	6,000
145					--	2,000	27,000	28,000			2,000	6,000
155					--	4,000	6,000	10,000			2,000	6,000
165					4,000	2,000	8,000	13,000			2,000	6,000
175					4,000	7,000	13,000	23,000			2,000	6,000
185					9,000	4,000	6,000	19,000			2,000	6,000
195					4,000	2,000	8,000	13,000			2,000	6,000
250					51,000	36,000	63,000	149,000			2,000	6,000
350					105,000	73,000	87,000	265,000			2,000	6,000
Total	15,000	25,000	84,000	123,000	227,000	205,000	482,000	913,000	9,000	17,000	55,000	83,000

See footnotes at end of table, p. 17.

Table 7.--Area^{1/} of conifer stands by stocking, age class, and productivity on five National Forest working circles

in western Washington and western Oregon (continued)

(In acres)

Age class	Stocking 70+			Stocking 40-69			Stocking 0-39					
	High	Medium	Low	Total	High	Medium	Low	Total	High	Medium	Low	Total
Western Oregon												
15 ^{2/}				4,000	33,000	81,000	118,000		2,000	2,000	7,000	11,000
25	--	2,000	13,000	15,000	--	2,000	24,000	26,000	--	2,000	11,000	13,000
35	--	2,000	9,000	9,000	2,000	43,000	44,000	44,000	--	2,000	15,000	15,000
45	--	--	15,000	15,000	9,000	19,000	28,000	28,000	--	4,000	34,000	38,000
55	4,000	2,000	15,000	21,000	4,000	13,000	26,000	43,000	--	2,000	37,000	39,000
65	4,000	9,000	26,000	39,000	2,000	10,000	28,000	39,000	2,000	11,000	45,000	58,000
75 ^{4/}	2,000	7,000	28,000	37,000	2,000	4,000	30,000	35,000	4,000	--	36,000	39,000
85 ^{4/}					--	15,000	24,000	39,000	2,000	2,000	11,000	13,000
95					2,000	6,000	32,000	39,000	2,000	4,000	13,000	19,000
105					4,000	19,000	27,000	50,000				
115					2,000	9,000	28,000	38,000				
125					6,000	17,000	20,000	43,000	2,000	15,000	45,000	62,000
135					--	6,000	26,000	31,000				
145					4,000	17,000	28,000	48,000				
155					8,000	11,000	15,000	33,000				
165					2,000	4,000	32,000	37,000				
175					2,000	6,000	22,000	30,000				
185					--	7,000	9,000	16,000	6,000	24,000	183,000	213,000
195					--	17,000	31,000	48,000				
250					15,000	88,000	216,000	319,000				
350					31,000	84,000	126,000	242,000				
Total	9,000	20,000	91,000	120,000	88,000	388,000	900,000	1,376,000	18,000	66,000	437,000	520,000

1/ Data as of date of inventory. Inventory dates of National Forest working circles are: south Mount Baker, 1965; Gifford Pinchot, 1969; Rogue River, 1967; Siskiyou, 1967; and Umpqua, 1968-69.

2/ For age 5 all stocking categories are combined.

3/ For ages 15, 25, and 35 stocking limits are 0-29 and 30+. For ages 15 and 25 all stocking 30+ is combined.

4/ For ages 85+ all stocking 40+ is combined.

Table 8.--Area^{1/} ^{2/} in 15- and 25-year conifer stands by trees per acre, productivity, and owner in western Washington and western Oregon

(In ^{3/} acres)

Age class	Other public ^{3/}								Forest industry						Forest industry--Continued				Other private							
	High		Medium		Low		Total		High		Medium		Low		Total		High		Medium		Low		Total			
	450 or more	Less than 450	450 or more	Less than 450	450 or more	Less than 450	450 or more	Less than 450	450 or more	Less than 450	450 or more	Less than 450	450 or more	Less than 450	450 or more	Less than 450	450 or more	Less than 450	450 or more	Less than 450	450 or more	Less than 450	450 or more	Less than 450		
Western Washington																										
15	11,000	2,000	17,000	24,000	24,000	3,000	52,000	29,000	55,000	18,000	52,000	2,000	00	1,000	148,000	21,000	11,000	--	16,000	--	21,000	2,000	48,000	2,000		
25	17,000	--	37,000	14,000	28,000	16,000	83,000	30,000	62,000	14,000	17,000	30,000	00	7,000	93,000	51,000	22,000	--	24,000	--	53,000	4,000	99,000	4,000		
Total	26,000	2,000	54,000	39,000	52,000	19,000	134,000	60,000	117,000	32,000	69,000	32,000	00	8,000	241,000	72,000	33,000	--	41,000	--	74,000	6,000	147,000	6,000		
Western Oregon																										
15	14,000	--	8,000	--	--	7,000	21,000	7,000	17,000	12,000	--	35,000	00	56,000	25,000	104,000	30,000	--	8,000	14,000	--	--	38,000	14,000		
25	--	8,000	--	--	--	--	--	8,000	14,000	29,000	8,000	8,000	--	8,000	22,000	45,000	23,000	23,000	14,000	7,000	--	--	37,000	29,000		
Total	14,000	8,000	8,000	--	--	7,000	21,000	15,000	31,000	42,000	8,000	44,000	00	64,000	46,000	149,000	53,000	23,000	22,000	21,000	--	--	74,000	43,000		

^{1/} Data are as of date of inventory and have not been adjusted to agree with updated area statistics.
Inventory dates are: western Oregon, 1961-62; southwest Washington, 1963; Olympic Peninsula, 1965; and Puget Sound, 1966.

^{2/} Excludes stands with less than 30 percent of normal stocking.

^{3/} All public ownerships except National Forests.



Table 9.--Area^{1/} ^{2/} in 15- and 25-year conifer stands by trees per acre and productivity for five National Forest working circles in western Washington and western Oregon
(In acres)

Age class	High		Medium		Low		Total	
	450 or more	Less than 450						
Western Washington								
15	--	2,000	--	4,000	13,000	4,000	13,000	9,000
25	--		--	--	4,000	2,000	4,000	2,000
Total	--	2,000	--	4,000	17,000	6,000	17,000	11,000
Western Oregon								
15	--	--	2,000	--	16,000	7,000	18,000	7,000
25	--	--	2,000	--	41,000	2,000	43,000	2,000
Total	--	--	4,000	--	57,000	9,000	61,000	9,000

^{1/} Data as of date of inventory. Inventory dates of National Forest working circles are: south Mount Baker, 1965; Gifford Pinchot, 1969; Rogue River, 1967; Siskiyou, 1967; and Umpqua, 1968-69.

^{2/} Excludes stands with less than 30 percent of normal stocking.

Table 10.--Area of commercial forest land^{1/} by age class on National Forest land, in western Washington and western Oregon

(In acres)

Age	Western Washington	Western Oregon
Nonstocked	88,000	198,000
< 6	129,000	152,000
10	49,000	132,000
20	18,000	100,000
30	42,000	69,000
40	57,000	181,000
50	63,000	131,000
60	53,000	225,000
70	31,000	174,000
80	52,000	179,000
90	20,000	85,000
100	48,000	173,000
>100	748,000	1,909,000
Mixed age >100	130,000	338,000
Mixed age <100	240,000	703,000
Mixed age unclassified	97,000	73,000
Total	1,867,000	4,822,000

^{1/} Data are from inventory or management plan statistics. For certain forests the area base is total commercial forest land; for others only area of commercial forest land classified as "timber key value" is included. Dates of published data range from 1962 to 1970.

APPENDIX

STAND CLASSIFICATION

We used Forest Survey inventory data to develop the data base from which candidate stands could be identified for management treatments. Ideally for this purpose, we would like to identify very uniform stands that are homogeneous with respect to present and future yield without additional treatment, with respect to response to treatments, and with respect to costs of treatments, because these factors are important determinants of economic feasibility and potential harvest.

However, Forest Survey inventory field data collection procedures are designed to obtain relatively complete information on the total tree population within a sample area. This includes recording information on all trees ranging in size from seedlings through mature sawtimber. Usually, stand attributes such as age or stocking are developed from all of the measured components. However, in defining management or treatment opportunities, not all components of a stand are viewed equally. A case in point would be a mature sawtimber stand with sapling or poletimber components. Where harvesting methods would destroy these smaller trees, they are of no interest to the forest manager and should not be counted in stocking nor considered in determining stand age. Similarly, in a predominantly young stand, the residual large older sawtimber trees--which currently enter into Survey stocking determination--should not be considered in economic analysis of thinning opportunities and have been omitted in our procedures.

The variables we used to identify candidate stands were stocking by softwoods and hardwoods, age class, and trees per acre. We also stratified all areas by productivity classes. The following sections define these variables as we employed them.

Stocking

Stocking is the measure used to indicate how well the productive potential of the forest is being utilized. In assessing opportunities in terms of stocking, stands which contain just enough trees to realize the productive potential of the forest usually need no additional treatment beyond perhaps fertilization. Stands with more stocking offer opportunity to increase value or total yields by reducing stocking to fewer but more desirable trees and by offsetting loss through mortality. If stocking is less than desirable, other alternatives such as reinforcement planting or regeneration cutting might be examined. Whether or not management opportunities exist and the nature of the opportunities thus depend heavily on stocking.

Normal yield tables are used as the basis for establishing stocking standards. These tables are developed from even-aged and usually single-species stands. However, Forest Survey sample plots may be of mixed species, mixed age, or both. We therefore use a stocking standard that is a weighted average of the various species and age classes present by treating each tree individually as if it were growing in a stand of trees of like species and stage of development.

The individual tree approach is based on the hypothesis that the growing space occupied by a tree is related to the species and diameter. That is, a tree of a given species and diameter utilizes the same growing space, regardless of the kind of stand in which it is located. Thus a tree, that if growing in a homogeneous stand would represent 5 percent of a normal stand, will contribute 5 percent to the stocking measure regardless of the type of stand in which it is located.

The stocking percents that we use in this analysis are therefore percents of "normal" stocking. There is a departure from this method, however, for trees under 5.0 inches d.b.h. Our philosophy is that seedling and sapling stands are fully stocked when they contain enough trees to utilize the full growth potential of the site by the time the stands reach 5.0 inches d.b.h. Therefore, the percent stocking contribution of a tree less than 5.0 inches d.b.h. is discounted for anticipated mortality. The factors applied to stocking of these trees are:

3.0-4.9 inches d.b.h.	0.95
1.0-2.9 inches d.b.h.	0.87
Less than 1.0 inch d.b.h.	0.79

In establishing the stocking classes necessary to identify treatment opportunities, we identified the stand components as follows:

(1) Softwood or hardwood type.

Based on majority of stocking including all live sound trees of commercial species.

(2) Treatment opportunities in softwood stands.

- a. For precommercial thinning, only stand ages 15 and 25 were considered and all live trees were included in establishing numbers of trees.
- b. For all other treatments including commercial thinning, fertilization, and harvest cutting, only live sound softwood trees were included in our definition of stocking. In stands classified by Survey as sawtimber, seedlings and saplings were not included; in poletimber stands, seedlings were not included.

Stand age

Our purpose in defining stand age is to identify the stand component that represents the "management opportunity." Stands in the Douglas-fir region that do not exhibit a clear even-age pattern will often be managed for the "important" component, ignoring the other components. For this reason and also because we don't know how to project management of mixed-age stands, we classified all stands into even-age stands by 10-year age classes.

Ten-year stand ages were assigned to conifer and hardwood stands based on calculations of stocking in live sound softwoods in softwood stands and live

sound hardwoods in hardwood stands. Stocking was arrayed in 10-year age classes from 10 through 200. We then looked at the sums of stocking for all combinations of three adjacent 10-year age classes to identify the group with the highest sum. The tentative stand age assigned would be the middle one of these three, unless one of the end classes contained over 50 percent of the stocking in the group, in which case that age class would be the tentative stand age. Beyond age class 200, Survey data recognize only age 250 and 350 and older. Since we are not interested in old-growth stands in terms of treatment opportunities, we are not particularly concerned with these older age classes. However, if we have a higher percent stocking in either the 250 or 350 age class than we do in the triplet used to set the tentative age, we would put this stand in the 155-year-and-older category.

Site Productivity

Our site classification is based on Survey-defined site indices. Our "medium" site includes Douglas-fir site indices 130, 140, and 150. Site indices above and below that range are "high" and "low," respectively. For conifer-site trees other than Douglas-fir, "medium" site included those site indices for which the cubic-foot mean annual increment at culmination was comparable to that for Douglas-fir. This would include, for example, western hemlock site indices 100 and 110. "High" and "low" sites were treated similarly. Most Forest Survey site trees are conifers (even on hardwood stands). Where the site tree was a hardwood and we wanted a conifer site productivity (to evaluate stand conversion), we converted, using the site equivalencies assumed in Yoho et al.³

³James G. Yoho, Daniel E. Chappelle, and Dennis L. Schweitzer. *The economics of converting red alder to Douglas-fir.* USDA For. Serv. Res. Pap. PNW-88, 1969. Pac. Northwest For. & Range Exp. Stn., Portland, Oreg.

Fight, Roger D., and Donald R. Gedney
1973. The land base for management of young-
growth forests in the Douglas-fir region.
USDA For. Serv. Res. Pap. PNW-159,
24 p., illus. Pacific Northwest Forest
and Range Experiment Station, Portland,
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The condition and extent of existing young-growth
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2. Development and evaluation of alternative methods and levels of resource management.
3. Achievement of optimum sustained resource productivity consistent with maintaining a high quality forest environment.

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